PATENT ABSTRACTS OF JAPAN

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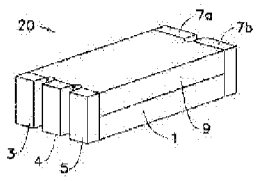
(54) METHOD OF MANUFACTURING ELECTROMAGNETIC CONVERSION ELEMENT



(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method easily manufacturing an electromagnetic conversion element having various shapes corresponding to various detection widths and magnetic patterns.
SOLUTION: A mother substrate 1 whereon a plurarity of independent magnetoresistive effect films are previously formed is prepared. Next, this mother substrate 1 is cut off in a specific dimension forming conductive films on the end faces to be partially removed using multiwire saw. Through these manufacturing procedures, an input electrode 3, an output electrode 4, a ground electrode 5, connecting electrodes 7a, 7b connecting to the magnetoresistive electric films can be easily formed. Accordingly, the electromagnetic conversion element having various detecting widths and at element intervals can be

manufactured without cutting out a new pattern at all.

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CLAIMS

[Claim(s)]

[Claim 1] The substrate which has a principal plane and an end face, and two or more magneto-resistive effect film which has the band-like configuration formed in the principal plane of a substrate by separating fixed spacing mutually, At least one connection electrode which connects mutually electrically the magneto-resistive effect film of arbitration chosen from the magneto-resistive effect film of these plurality, In the

manufacture approach of a galvanomagnetic device of having one input electrode which is electrically connected to the magneto-resistive effect film of arbitration, respectively and which was formed in the end face of a substrate, respectively, at least one output electrode, and at least one earth electrode The process which forms two or more magneto-resistive effect film for the galvanomagnetic devices of a part in one mother substrate, and where the die length and the number of magneto-resistive effect film are chosen as arbitration for the mother substrate While forming the electric conduction film in the end face of the process cut for every galvanomagnetic device, and the substrate of each of that disconnected galvanomagnetic device The manufacture approach of the galvanomagnetic device characterized by having the process which forms a connection electrode, an input electrode, an output electrode, and an earth electrode by removing the electric conduction film in a predetermined part.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of the galvanomagnetic device for changing change of a magnetic field into an electric resistance value change.
[0002]
[Description of the Prior Art] In order that the galvanomagnetic device which has a magneto-resistive effect and which comes to form the film of InSb in a substrate, for example may detect a motion of a detected object from the former, it is put in practical use as a position sensor. The conventional galvanomagnetic device 30 is explained using the

important section top view of drawing 3 , and the explanatory view of drawing 4 .
[0003] As the conventional galvanomagnetic device 30 is shown in drawing 3 , the 1st magnetic force sencor 2a and 2nd magnetic force sencor 2b are formed in the principal plane of a substrate 1, and it comes to form an input electrode 3, an output electrode 4, and an earth electrode 5 in the end face of a substrate 1.
[0004] Two magneto-resistive effect film 6a and 6b is connected by connection electrode 7a, and, as for 1st magnetic force sencor 2a, the input electrode 3 is constituted by the end of 1st magnetic force sencor 2a by connecting an output electrode 4, respectively through 7d of connection electrodes at the other end through electric conduction film 7c. Two magneto-resistive effect film 6c and 6d is connected by connection electrode 7b, and, as for 2nd magnetic force sencor 2b, the output electrode 4 is constituted by the end of 2nd magnetic force sencor 2b by connecting an earth electrode 5, respectively through electric conduction film 7e at the other end through 7d of connection electrodes. the short circuit-on magneto-resistive effect filma [6],b [6], and 6c and 6d film 8 and 8 of plurality respectively ... forms -- having -- further -- a it top -- the magneto-resistive effect film 6a, 6b, 6c, and 6d and two or more short circuit film 8 and 8 -- the protective coat 9 for protecting ..., the electric conduction film 7c and 7e, and the connection electrodes 7a, 7b, and 7d is formed. in addition, drawing 3 -- setting -- two or more short circuit film 8 and 8 ... and a protective coat 9 are not illustrated.
[0005] since an input electrode 3, an output electrode 4, and an earth electrode 5 are connected to magnetic force sencor 2a of the pair formed on the substrate 1, and 2b and the galvanomagnetic device 30 is constituted as a two-element 3 terminal mold galvanomagnetic device so that it may illustrate, the detected body (not shown) which has a magnetic pattern corresponding to spacing shown by the die length shown all over [d1] drawing and d2 is detected -- as -- ******.
[0006] The explanatory view of drawing 4 R> 4 is used for below, and the manufacture approach of a galvanomagnetic device 30 is explained to it. in addition, drawing 4 -- two or more galvanomagnetic devices 30 and 30 -- it is drawing in the middle of manufacture of ..., and a cross section when the A-A line of drawing 3 cuts is shown.
[0007] The bulk wafer -10 and the mother substrate 11 which consist of InSb first are prepared.
[0008] Next, as shown in drawing 4 (1), the bulk wafer -10 is pasted up on the mother substrate 11 with resin 12. In addition, two or more

galvanomagnetic devices 30 are formed in this mother substrate 11 at coincidence.
[0009] Next, as shown in drawing 4 (2), the bulk wafer -10 is thin-film-ized by wrapping or etching, and the InSb thin film layer 13 is formed.
[0010] next, the magneto-resistive effect film 14 and 14 which has two or more predetermined configurations for the InSb thin film layer 13 by the photolithography method using a mask pattern as shown in drawing 4 (3) -- it forms in ...
[0011] next, it is shown in drawing 4 (4) -- as -- the magneto-resistive effect film 14 and 14 ... a top -- a vacuum deposition method -- using -- the high metal of electrical conductivity -- vapor-depositing -- further -- the photolithography method -- the short circuit film 8 and 8 -- although ... and illustration are not carried out, it forms in the connection electrodes 7a, 7b, and 7d and the electric conduction film 7c and 7e.
[0012] next, two or more short circuit film 8 and 8 formed in the mother substrate 11 as shown in drawing 4 (5) ... and the magneto-resistive effect film 14 and 14 -- in order to protect ... two or more short circuit film 8 and 8 ... and the magneto-resistive effect film 14 and 14 -- a protective coat 9 is formed by the sputtering method or the spin-on glass method all over ... two or more short circuit film 8 and 8 protected by the protective coat 9 even at this process ... and the magneto-resistive effect film 14 and 14 ... is formed on the mother substrate 11.
[0013] Next, as shown in drawing 4 (6), a dicing saw cuts the mother substrate 11 for each component. The edge of the magneto-resistive effect film 14 is exposed to the end face of each component with this cutting.
[0014] Next, although illustration is not carried out, the alloy of 3 yuan of Ag metal, or Cu and nickel is formed for an input electrode 3, an output electrode 4, and an earth electrode 5 using a mask pattern by the magnetron sputtering method so that it may connect with the magneto-resistive effect film 14 exposed to the end face.
[0015] The galvanomagnetic device 30 of a chip mold is obtained according to the above process.
[0016] In addition, as shown according to the same process in the galvanomagnetic device 40 of the two-element 3 terminal mold which has the long magneto-resistive effect film as shown in d3 of drawing 5 (1), and d4 of drawing 5 (2), the galvanomagnetic device 50 of a two-element 3 terminal mold with large spacing is manufactured using the mask pattern of the proper corresponding to each magneto-resistive effect

film and connection electrode, an input electrode, an output electrode, and an earth electrode. In addition, a number, spacing, etc. of the magneto-resistive effect film which are formed in a mother substrate in these cases may differ from the above-mentioned conventional example.
[0017]
[Problem(s) to be Solved by the Invention] According to the application, various things are required for the die length of the magneto-resistive effect [galvanomagnetic device] film according to detection width of face, and spacing of the magneto-resistive effect film corresponding to a magnetic pattern. Therefore, the work period was also required, while the mask pattern of the proper which has various configurations for forming each magneto-resistive effect film was needed and requiring the work costs.
[0018] In order to manufacture the galvanomagnetic device from which it is made in order that this invention may solve the above-mentioned trouble, and the die length of the magneto-resistive effect film and spacing differ By forming two or more magneto-resistive effect film on a mother substrate beforehand, cutting to predetermined die length with a mother substrate, forming the electric conduction film linked to the magneto-resistive effect film exposed to the cutting plane, and removing a part of this electric conduction film The galvanomagnetic device from which the die length of the magneto-resistive effect film and spacing differ can be easily manufactured now by the approach of forming in an input electrode, an output electrode, an earth electrode, and a connection electrode.
[0019]
[Means for Solving the Problem] The substrate with which the manufacture approach of the galvanomagnetic device of this invention has a principal plane and an end face, Two or more magneto-resistive effect film which has the band-like configuration formed in the principal plane of a substrate by separating fixed spacing mutually, At least one connection electrode which connects mutually electrically the magneto-resistive effect film of arbitration chosen from the magneto-resistive effect film of these plurality, In the manufacture approach of a galvanomagnetic device of having one input electrode which is electrically connected to the magneto-resistive effect film of arbitration, respectively and which was formed in the end face of a substrate, respectively, at least one output electrode, and at least one earth electrode The process which forms two or more magneto-resistive effect film for the galvanomagnetic devices of a part in one mother substrate, and where the die length and the number of magneto-resistive effect film are chosen as arbitration

for the mother substrate It is characterized by having the process cut for every galvanomagnetic device, and the process which forms a connection electrode, an input electrode, an output electrode, and an earth electrode by removing the electric conduction film in a predetermined part while forming the electric conduction film in the end face of the substrate of each of that disconnected galvanomagnetic device.

[0020]

[Embodiment of the Invention] The gestalt of operation of this invention is explained using drawing 1 and 2. In addition, about the same part as the conventional example, the explanation is omitted using the same sign.

[0021] The perspective view of a galvanomagnetic device 20 by which drawing 1 was manufactured according to one example of this invention, and drawing 2 are the perspective views showing two or more magneto-resistive effect film formed on the mother substrate in the middle of manufacture of a galvanomagnetic device.

[0022] The galvanomagnetic device 20 has a substrate 1, the 1st and 2nd magnetic force sencors which were protected by the protective coat 9 and which are not illustrated, an input electrode 3, an output electrode 4, an earth electrode 5, and the connection electrodes 7a and 7b, as shown in drawing 1 .

[0023] Next, the manufacture approach of a galvanomagnetic device 20 is explained in order.

[0024] first, two or more magneto-resistive effect film 14 and 14 protected by the protective coat 9 as shown by drawing 2 according to the same process as the manufacture approach of the conventional galvanomagnetic device -- the mother substrate 11 with which ... was formed is prepared.

[0025] Next, the magneto-resistive effect film 14 which has a predetermined number and die length is cut down by cutting the mother substrate 11.

[0026] next, the magneto-resistive effect film 14 and 14 exposed to two end faces 15 and 15 which a substrate 1 faces -- the electric conduction film is formed all over end faces 15 and 15 so that it may connect with ... The electric conduction film forms the alloy of 3 yuan of Ag metal, or Cu and nickel by the same approach as the case of the conventional galvanomagnetic device using the magnetron sputtering method.

[0027] Next, an input electrode 3, an output electrode 4, and an earth electrode 5 are formed by removing some of one electric conduction film using a multi-wire saw. The connection electrodes 7a and 7b are formed

by removing some electric conduction film of another side similarly.
[0028] The two-element 3 terminal mold galvanomagnetic device 20 by which two magnetic force sencor 2a and the ends of 2b (not shown) were connected with the output electrode 4, respectively, the input electrode 3 was connected to the other end of magnetic force sencor 2a, and the earth electrode 5 was connected to the other end of magnetic force sencor 2b according to the process mentioned above, respectively as shown in drawing 1 is obtained.
[0029] In addition, as shown in drawing 6 , the galvanomagnetic device 60 with the large spacing d4 of the magneto-resistive effect film which actually operates can also be manufactured by not connecting some magneto-resistive effect film electrically.
[0030] In addition, although the etching approach etc. can be used other than the approach by the above multi-wire saws as a means to remove some electric conduction film, it cannot be overemphasized that it is not limited to this approach.
[0031] According to the manufacture approach of the galvanomagnetic device of this invention, it can manufacture, without newly preparing the mask pattern corresponding to each for various galvanomagnetic devices which have a different number and the magneto-resistive effect film of die length. That is, by cutting the mother substrate with which sufficient two or more long magneto-resistive effect film prepared beforehand was formed, forming the electric conduction film in an end face, and removing a part of the electric conduction film, it can form in an input electrode, an output electrode, an earth electrode, and a connection electrode freely, and a desired galvanomagnetic device can be manufactured. Moreover, by preparing the magneto-resistive effect film which does not function electrically, spacing of the magneto-resistive effect film which actually operates can also be set up freely.
[0032] Therefore, various galvanomagnetic devices which have the magneto-resistive effect film of a different configuration can be manufactured by low cost for a short period of time.
[0033]
[Effect of the Invention] According to the manufacture approach of the galvanomagnetic device of this invention, the mother substrate with which the magneto-resistive effect film with which plurality became independent beforehand was formed is prepared, it cuts in a predetermined dimension, the electric conduction film is formed in an end face, and said electric conduction film is formed in an input electrode, an output electrode, an earth electrode, or a connection electrode. That is, since it can manufacture without preparing the mask

pattern [galvanomagnetic device / which has the magnetic force sencor of various configurations with which the die length of the magneto-resistive effect film differs from the number] according to each configuration, it can manufacture by low cost for a short period of time.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view of the one example galvanomagnetic device of this invention.
[Drawing 2] It is a perspective view in the middle of manufacture of the one example galvanomagnetic device of this invention.
[Drawing 3] It is the important section top view of the conventional galvanomagnetic device.
[Drawing 4] It is an explanatory view explaining the production process of the conventional galvanomagnetic device.
[Drawing 5] It is the important section top view of conventional various galvanomagnetic devices.
[Drawing 6] It is the important section top view of another example galvanomagnetic device of this invention.
[Description of Notations]
1 [ ] Substrate
2a, 2b Magnetic force sencor
3 [ ] Input Electrode
4 [ ] Output Electrode
5 [ ] Earth Electrode
6a, 6b, 6c, 6d Magneto-resistive effect film
7a, 7b, 7d Connection electrode
7c, 7e Electric conduction film

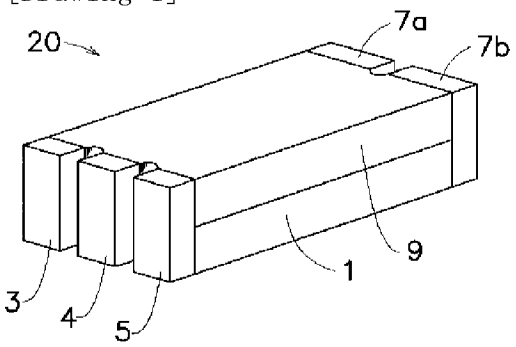
8 [ ] Short Circuit Film
9 [ ] Protective Coat
10 [ ] Bulk Wafer -
11 [ ] Mother Substrate
12 [ ] Resin
13 [ ] InSb Thin Film Layer
14 [ ] Magneto-resistive Effect Film
15 [ ] End Face
20, 30, 40, 50, 60 Galvanomagnetic device

[Translation done.]

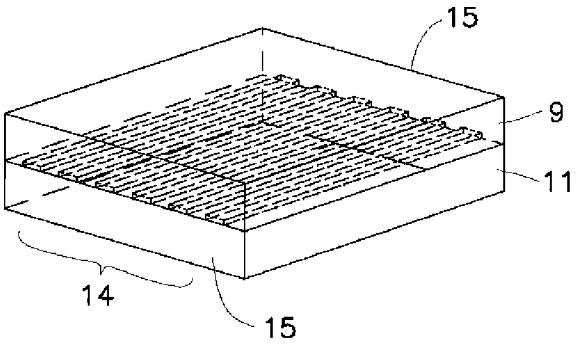
* NOTICES *

DRAWINGS

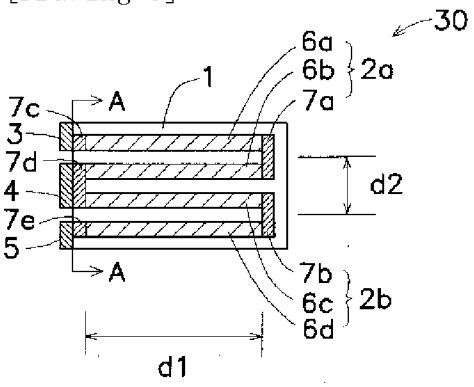
[Drawing 1]



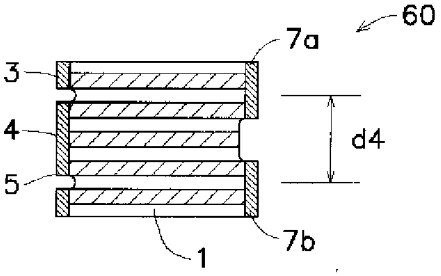
[Drawing 2]



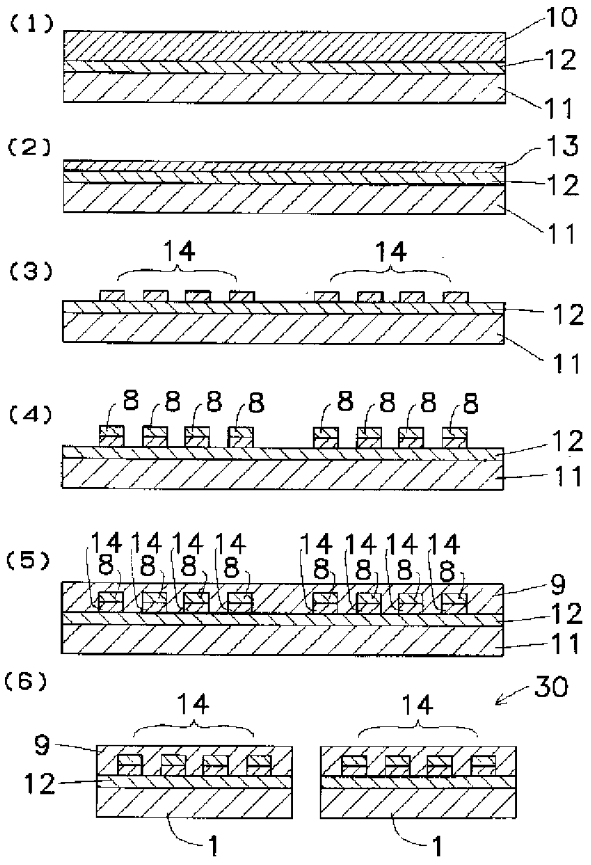
[Drawing 3]



[Drawing 6]



[Drawing 4]


(1)
10
12
11
(2)
13
12
11
(3)
14
14
12
11
(4)
8
12
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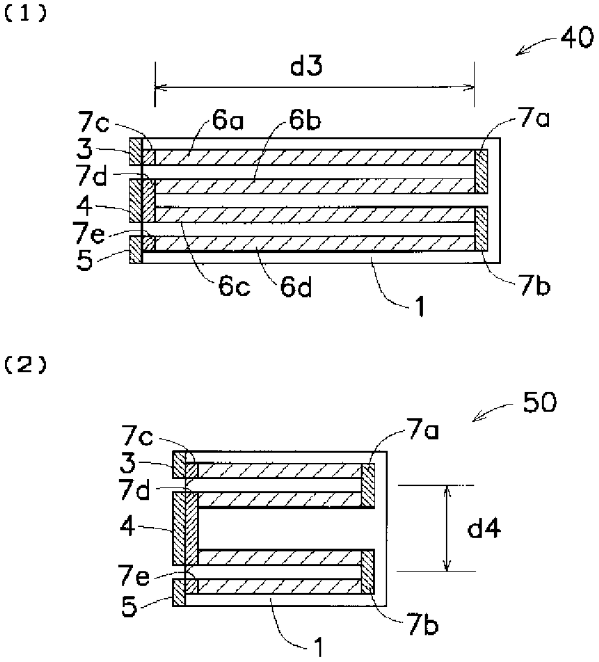
(5)
14
9
12
11
(6)
30
14
14
9
12
1
1

[Drawing 5]


(1)
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d3
7c
6a
6b
7a
3
7d
4
7e
5
6c
6d
1
7b
(2)
50
7c
7a
3
7d
4
d4
7e
5
7b
1

[Translation done.]

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審査請求　未請求　請求項の数１　ＯＬ　（全　５　頁）

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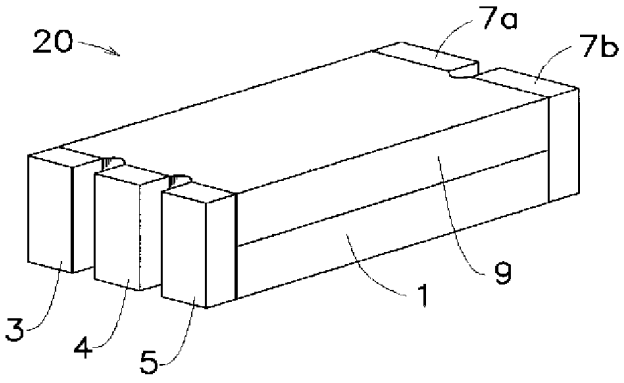
(54)【発明の名称】　磁電変換素子の製造方法

(57)【要約】　（修正有）

【課題】　検知幅や異なる磁気パターンに対応する種々の形状を有する磁電変換素子を容易に製造する方法を提供する。

【解決手段】　あらかじめ複数個の独立した磁気抵抗効果膜が形成された母基板１を準備する。この母基板１を所定の寸法に切断し、端面に導電膜を形成し、前記導電膜をマルチワイヤーソーを用いて部分的に除去する。この製造方法により、磁気抵抗効果膜に接続する入力電極３や、出力電極４や、接地電極５や、接続電極７ａ、７ｂを容易にに形成する。

【効果】　マスクパターンをあらたに作らずに、様々な検知幅や素子間隔を有する磁電変換素子を製造できる。



【特許請求の範囲】
【請求項１】　主面と端面とを有する基板と、
基板の主面に互いに一定の間隔を隔てて形成された帯状形状を有する複数の磁気抵抗効果膜と、
それら複数の磁気抵抗効果膜から選ばれる任意の磁気抵抗効果膜を互いに電気的に接続する、少なくとも１個の接続電極と、
任意の磁気抵抗効果膜にそれぞれ電気的に接続する、それぞれ基板の端面に形成された、１個の入力電極と、少なくとも１個の出力電極と、少なくとも１個の接地電極とを有する磁電変換素子の製造方法において、
複数個分の磁電変換素子用の磁気抵抗効果膜を一枚の母基板に形成する工程と、
その母基板を、磁気抵抗効果膜の長さおよび数を任意に選択した状態で、各磁電変換素子ごとに切断する工程と、
その切断された各磁電変換素子の基板の端面に導電膜を形成するとともに、その導電膜を所定箇所で除去することによって、接続電極、入力電極、出力電極、接地電極を形成する工程を有することを特徴とする磁電変換素子の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】　本発明は、磁場の変化を電気抵抗値の変化に変換するための磁電変換素子の製造方法に関する。
【０００２】
【従来の技術】　従来から、磁気抵抗効果を有する例えばＩｎＳｂの膜が基板に形成されてなる磁電変換素子が、被検知物の動きを検出するために、位置センサとして実用化されている。従来の磁電変換素子３０を図３の要部平面図および図４の説明図を用いて説明する。
【０００３】従来の磁電変換素子３０は、図３に示すように、基板１の主面に第１の感磁部２ａおよび第２の感磁部２ｂが形成され、基板１の端面に入力電極３、出力電極４および接地電極５が形成されてなる。
【０００４】第１の感磁部２ａは、２個の磁気抵抗効果膜６ａ、６ｂが接続電極７ａで接続され、第１の感磁部２ａの一端には導電膜７ｃを介して入力電極３が、他端には接続電極７ｄを介して出力電極４がそれぞれ接続されることにより構成されている。第２の感磁部２ｂは、２個の磁気抵抗効果膜６ｃ、６ｄが接続電極７ｂで接続され、第２の感磁部２ｂの一端には接続電極７ｄを介して出力電極４が、他端には導電膜７ｅを介して接地電極５がそれぞれ接続されることにより構成されている。磁気抵抗効果膜６ａ、６ｂ、６ｃ、６ｄ上には、それぞれ複数個の短絡膜８、８．．．が形成され、さらにその上に磁気抵抗効果膜６ａ、６ｂ、６ｃ、６ｄおよび複数個の短絡膜８、８．．．、導電膜７ｃ、７ｅ、接続電極７ａ、７ｂ、７ｄを保護するための保護膜９が形成されている。なお図３において、複数個の短絡膜８、８．．．および保護膜９は図示しない。
【０００５】磁電変換素子３０は、図示するように基板１上に形成された一対の感磁部２ａ、２ｂに、入力電極３と出力電極４と接地電極５とが接続されて二素子三端子型磁電変換素子として構成されているので、図中ｄ１で示す長さおよびｄ２で示す間隔に対応する磁気パターンを有する被検知体（図示せず）を検出するようにはたらく。
【０００６】以下に、磁電変換素子３０の製造方法を図４の説明図を用いて説明する。なお図４は、複数個の磁電変換素子３０、３０．．．の製造途中における図であって、図３のＡ－Ａ線で切断したときの断面を示す。
【０００７】まずＩｎＳｂからなるバルクウェハー１０および母基板１１を準備する。
【０００８】次に図４（１）に示すように、母基板１１にバルクウェハー１０を樹脂１２により接着する。なおこの母基板１１には、複数個の磁電変換素子３０が同時に形成される。
【０００９】次に図４（２）に示すように、バルクウェハー１０をラッピングまたはエッチングにより薄膜化し、ＩｎＳｂ薄膜層１３を形成する。
【００１０】次に図４（３）に示すように、マスクパターンを用いるフォトリソグラフィー法により、ＩｎＳｂ薄膜層１３を複数個の所定の形状を有する磁気抵抗効果膜１４、１４．．．に形成する。
【００１１】次に図４（４）に示すように、磁気抵抗効果膜１４、１４．．．上に真空蒸着法を用いて電気伝導性の高い金属を蒸着し、さらにフォトリソグラフィー法により、短絡膜８、８．．．と図示はしないが接続電極７ａ、７ｂ、７ｄ、導電膜７ｃ、７ｅに形成する。
【００１２】次に図４（５）に示すように、母基板１１に形成された複数個の短絡膜８、８．．．および磁気抵抗効果膜１４、１４．．．を保護するために、複数個の短絡膜８、８．．．および磁気抵抗効果膜１４、１４．．．の全面に、保護膜９をスパッタリング法あるいはスピンオングラス法により形成する。この工程までで、保護膜９で保護された複数個の短絡膜８、８．．．および磁気抵抗効果膜１４、１４．．．が、母基板１１上に形成される。
【００１３】次に図４（６）に示すように、ダイシングソーにより、母基板１１を個々の素子に切断する。この切断により、磁気抵抗効果膜１４の端部が個々の素子の端面に露出する。
【００１４】次に図示はしないが、端面に露出した磁気抵抗効果膜１４に接続するように、入力電極３、出力電極４、接地電極５を、Ａｇ金属あるいはＣｕとＮｉとの合金を三元マグネトロンスパッタリング法によりマスクパターンを用いて形成する。
【００１５】以上の工程によりチップ型の磁電変換素子

３０が得られる。
【００１６】なお同様の工程により、図５（１）のｄ３で示すように長い磁気抵抗効果膜を有する二素子三端子型の磁電変換素子４０や、図５（２）のｄ４で示すように間隔が広い二素子三端子型の磁電変換素子５０が、それぞれの磁気抵抗効果膜や接続電極、入力電極、出力電極、接地電極に対応した固有のマスクパターンを用いて製造される。なおこれらの場合、母基板に形成される磁気抵抗効果膜の本数および間隔等が、上記従来例と異なる場合がある。
【００１７】
【発明が解決しようとする課題】　磁電変換素子は、検出幅に応じた磁気抵抗効果膜の長さや、磁気パターンに対応する磁気抵抗効果膜の間隔が、その用途に応じてさまざまなものが要求される。したがって、それぞれの磁気抵抗効果膜を形成するためのさまざまな形状を有する固有のマスクパターンが必要となり、その制作費用を要するとともに、制作期間も必要であった。
【００１８】本発明は上記問題点を解決するためになされたものであり、磁気抵抗効果膜の長さや間隔の異なる磁電変換素子を製造するために、あらかじめ母基板上に複数個の磁気抵抗効果膜を形成し、母基板とともに所定の長さに切断し、切断面に露出した磁気抵抗効果膜に接続する導電膜を形成し、この導電膜の一部を除去することにより、入力電極、出力電極、接地電極および接続電極とに形成するという方法により、磁気抵抗効果膜の長さや間隔の異なる磁電変換素子を容易に製造できるようになった。
【００１９】
【課題を解決するための手段】　本発明の磁電変換素子の製造方法は、主面と端面とを有する基板と、基板の主面に互いに一定の間隔を隔てて形成された帯状形状を有する複数の磁気抵抗効果膜と、それら複数の磁気抵抗効果膜から選ばれる任意の磁気抵抗効果膜を互いに電気的に接続する、少なくとも１個の接続電極と、任意の磁気抵抗効果膜にそれぞれ電気的に接続する、それぞれ基板の端面に形成された、１個の入力電極と、少なくとも１個の出力電極と、少なくとも１個の接地電極とを有する磁電変換素子の製造方法において、複数個分の磁電変換素子用の磁気抵抗効果膜を一枚の母基板に形成する工程と、その母基板を、磁気抵抗効果膜の長さおよび数を任意に選択した状態で、各磁電変換素子ごとに切断する工程と、その切断された各磁電変換素子の基板の端面に導電膜を形成するとともに、その導電膜を所定箇所で除去することによって、接続電極、入力電極、出力電極、接地電極を形成する工程を有することを特徴とする。
【００２０】
【発明の実施の形態】　本発明の実施の形態を図１、２を用いて説明する。なお従来例と同一の部分については同一の符号を用いその説明を省略する。
【００２１】図１は、本発明の一実施例によって製造された磁電変換素子２０の斜視図、図２は、磁電変換素子の製造途中において、母基板上に形成された複数の磁気抵抗効果膜を示す斜視図である。
【００２２】磁電変換素子２０は、図１に示すように、基板１と、保護膜９で保護された図示しない第１および第２の感磁部と、入力電極３と、出力電極４と、接地電極５と、接続電極７ａ、７ｂとを有している。
【００２３】次に磁電変換素子２０の製造方法を順に説明する。
【００２４】まず、従来の磁電変換素子の製造方法と同様の工程により、図２で示すような、保護膜９で保護された複数個の磁気抵抗効果膜１４、１４．．．が形成された母基板１１を準備する。
【００２５】次に、母基板１１を切断することにより、所定の本数および長さを有する磁気抵抗効果膜１４を切り出す。
【００２６】次に、基板１の相対する２個の端面１５、１５に露出した磁気抵抗効果膜１４、１４．．．に接続するように、端面１５、１５の全面に導電膜を形成する。導電膜は、従来の磁電変換素子の場合と同様の方法により、Ａｇ金属あるいはＣｕとＮｉとの合金を三元マグネトロンスパッタリング法を用いて形成する。
【００２７】次に、一方の導電膜の一部をマルチワイヤーソーを用いて除去することにより入力電極３と出力電極４と接地電極５を形成する。同様に他方の導電膜の一部を除去することにより接続電極７ａ、７ｂを形成する。
【００２８】上述した工程により、図１に示すように、２個の感磁部２ａ、２ｂ（図示せず）の一端どうしがそれぞれ出力電極４で接続され、感磁部２ａの他端に入力電極３が、感磁部２ｂの他端に接地電極５がそれぞれ接続された二素子三端子型磁電変換素子２０が得られる。
【００２９】なお、図６に示すように、一部の磁気抵抗効果膜が電気的に接続されないことにより、実際に動作する磁気抵抗効果膜の間隔ｄ４が広い磁電変換素子６０も製造することができる。
【００３０】なお、導電膜の一部を除去する手段としては、上記のようなマルチワイヤーソーによる方法の他に、エッチング方法などを用いることができるが、この方法に限定されないことはいうまでもない。
【００３１】本発明の磁電変換素子の製造方法によれば、異なる本数および長さの磁気抵抗効果膜を有する様々な磁電変換素子を、それぞれに対応したマスクパターンをあらたに準備することなく製造することができる。すなわち、あらかじめ準備した十分長い複数個の磁気抵抗効果膜が形成された母基板を切断し、端面に導電膜を形成しその導電膜の一部を除去することにより、入力電極や、出力電極や、接地電極や、接続電極に自由に形成して、所望の磁電変換素子を製造することができる。ま

た電気的に機能しない磁気抵抗効果膜を設けることにより、実際に動作する磁気抵抗効果膜の間隔を自由に設定することもできる。

【００３２】したがって異なる形状の磁気抵抗効果膜を有する様々な磁電変換素子を、短期間に低コストで製造することができる。

【００３３】

【発明の効果】　本発明の磁電変換素子の製造方法によれば、あらかじめ複数個の独立した磁気抵抗効果膜が形成された母基板を準備し、所定の寸法に切断し、端面に導電膜を形成し、前記導電膜を、入力電極や出力電極や接地電極や接続電極に形成する。すなわち、磁気抵抗効果膜の長さや個数の異なる様々な形状の感磁部を有する磁電変換素子を、それぞれの形状に応じたマスクパターンを準備することなく製造することができるので、短期間に、低コストで製造することができる。

【図面の簡単な説明】

【図１】本発明の一実施例磁電変換素子の斜視図である。

【図２】本発明の一実施例磁電変換素子の製造途中の斜視図である。

【図３】従来の磁電変換素子の要部平面図である。

【図４】従来の磁電変換素子の製造工程を説明する説明図である。

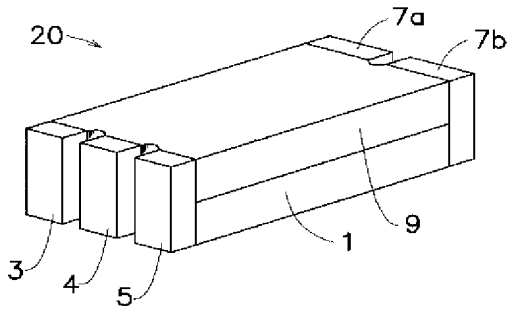
【図５】従来のさまざまな磁電変換素子の要部平面図である。

【図６】本発明の別の実施例磁電変換素子の要部平面図である。

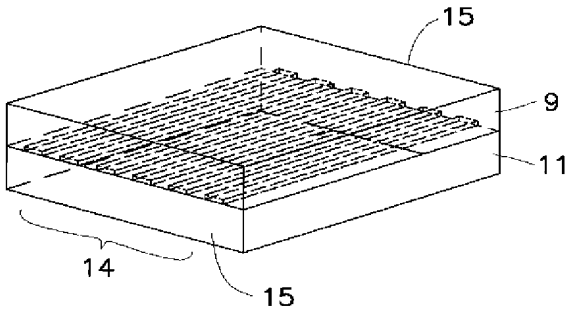
【符号の説明】

１	基板
２ａ、２ｂ	感磁部
３	入力電極
４	出力電極
５	接地電極
６ａ、６ｂ、６ｃ、６ｄ	磁気抵抗効果膜
７ａ、７ｂ、７ｄ	接続電極
７ｃ、７ｅ	導電膜
８	短絡膜
９	保護膜
１０	バルクウェハー
１１	母基板
１２	樹脂
１３	ＩｎＳｂ薄膜層
１４	磁気抵抗効果膜
１５	端面
２０、３０、４０、５０、６０	磁電変換素子

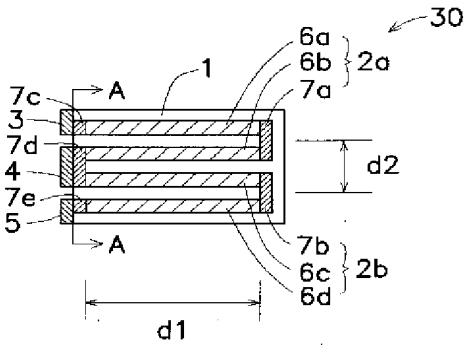
【図１】



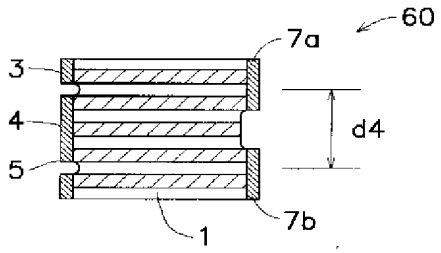
【図２】



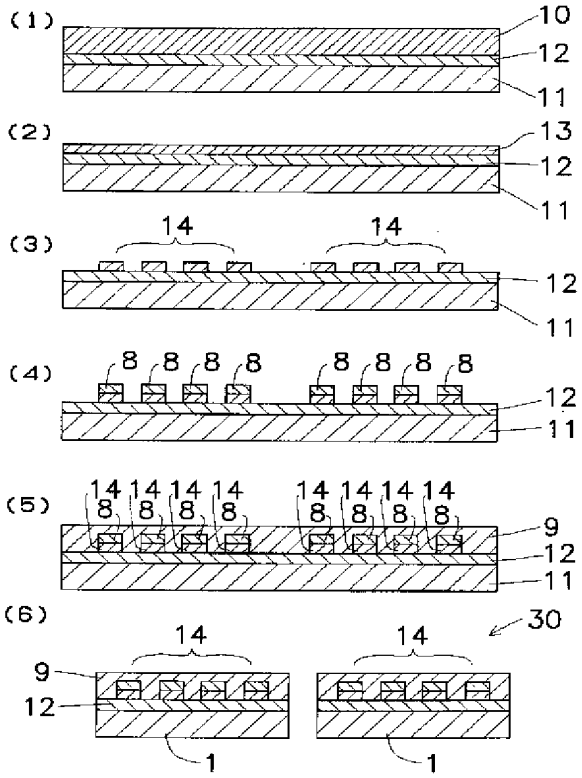
【図３】



【図６】



【図４】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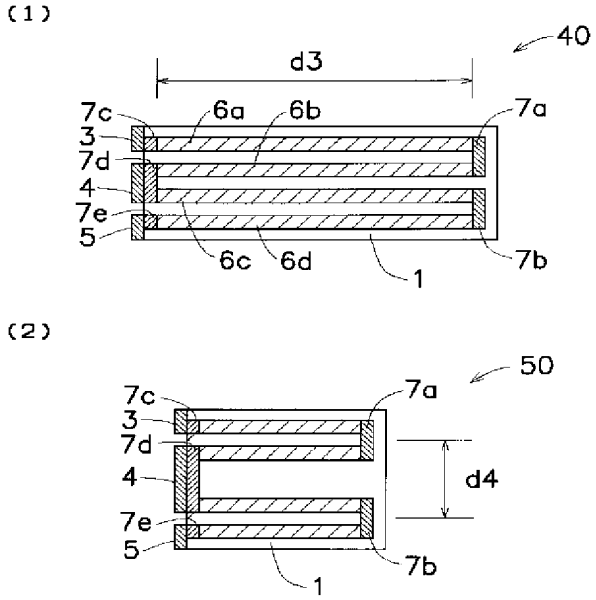
【図５】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7b